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PART 0 SAR CHAR REPORT

Applicant Name:
Microsoft Corporation
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Date of Testing:
06/21/2021– 09/09/2021
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
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APPLICANT: MICROSOFT CORPORATION

Report Type: Part 0 SAR Characterization
DUT Type: Portable Handset
Model(s): 1995

Note: This revised Test Report supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Test results reported herein relate only to the item(s) tested.

Randy Ortanez
President

ilac-MRA
A2LA ACCREDITED CERT #2041.01

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1 DEVICE UNDER TEST

A1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS 850	Voice/Data	824.20 - 848.80 MHz
GSM/GPRS 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
LTE Band 71	Voice/Data	665.5 - 695.5 MHz
LTE Band 12	Voice/Data	699.7 - 715.3 MHz
LTE Band 13	Voice/Data	779.5 - 784.5 MHz
LTE Band 14	Voice/Data	790.5 - 795.5 MHz
LTE Band 26 (Cell)	Voice/Data	814.7 - 848.3 MHz
LTE Band 5 (Cell)	Voice/Data	824.7 - 848.3 MHz
LTE Band 66 (AWS)	Voice/Data	1710.7 - 1779.3 MHz
LTE Band 4 (AWS)	Voice/Data	1710.7 - 1754.3 MHz
LTE Band 25 (PCS)	Voice/Data	1850.7 - 1914.3 MHz
LTE Band 2 (PCS)	Voice/Data	1850.7 - 1909.3 MHz
LTE Band 30	Voice/Data	2307.5 - 2312.5 MHz
LTE Band 7	Voice/Data	2502.5 - 2567.5 MHz
LTE Band 48	Voice/Data	3552.5 - 3697.5 MHz
LTE Band 41	Voice/Data	2498.5 - 2687.5 MHz
NR Band n71	Data	665.5 - 695.5 MHz
NR Band n5 (Cell)	Data	826.5 - 846.5 MHz
NR Band n66 (AWS)	Data	1712.5 - 1777.5 MHz
NR Band n25 (PCS)	Data	1852.5 - 1912.5 MHz
NR Band n2 (PCS)	Data	1852.5 - 1907.5 MHz
NR Band n41	Data	2506.02 - 2679.99 MHz
2.4 GHz WLAN	Voice/Data	2412 - 2472 MHz
U-NII-1	Voice/Data	5180 - 5240 MHz
U-NII-2A	Voice/Data	5260 - 5320 MHz
U-NII-2C	Voice/Data	5500 - 5720 MHz
U-NII-3	Voice/Data	5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
NR Band n260	Data	37000 - 40000 MHz
NR Band n261	Data	27500 - 28350 MHz
NFC	Data	13.56 MHz

This device uses the Qualcomm® Smart Transmit feature to control and manage transmitting power in real time and to ensure the time-averaged RF exposure is in compliance with the FCC requirement at all times for 2G/3G/4G/5G WWAN operations. Additionally, this device supports WLAN/BT/NFC technologies, but the output power of these modems is not controlled by the Smart Transmit algorithm.

A1.2 Time-Averaging for SAR and Power Density

This device is enabled with Qualcomm® Smart Transmit algorithm to control and manage transmitting power in real time and to ensure that the time-averaged RF exposure from 2G/3G/4G/5G Sub-6 NR WWAN is in compliance with FCC requirements. This Part 0 report shows SAR characterization of WWAN radios for 2G/3G/4G/5G Sub-6 NR. Characterization is achieved by determining P_{Limit} for 2G/3G/4G/5G Sub-6 NR that corresponds to the exposure design targets after accounting for all device design related uncertainties, i.e., SAR_design_target (< FCC SAR limit) for sub-6 radio. The SAR characterization is denoted as SAR Char in this report. Section 1.3 includes a nomenclature of the specific terms used in this report.

The compliance test under the static transmission scenario and simultaneous transmission analysis are reported in Part 1 report. The validation of the time-averaging algorithm and compliance under the dynamic (time- varying) transmission scenario for WWAN technologies are reported in Part 2 report (report SN could be found in Section 1.4 – Bibliography).

A1.3 Nomenclature for Part 0 Report

Technology	Term	Description
2G/3G/4G/5G Sub-6 NR	P_{limit}	Power level that corresponds to the exposure design target (*SAR_design_target)* after accounting for all device design related uncertainties
	P_{max}	Maximum tune up output power
	SAR_design_target	Target SAR level < FCC SAR limit after accounting for all device design related uncertainties
	SAR Char	Table containing *Plimit* for all technologies and bands

A1.4 Bibliography

Report Type	Report Serial Number
PD Exposure Part 0 Test Report	
Near Field PD Report (Part 1)	1M2105060048-20.C3K
RF Exposure Part 1 Test Report (Part 1)	1M2105060048-01.C3K
RF Exposure Part 2 Test Report	1M2105060048-21.C3K
RF Exposure Compliance Summary Report	1M2105060048-22.C3K

2 SAR AND POWER DENSITY MEASUREMENTS

A1.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 2-1).

Equation 2-1
SAR Mathematical Equation

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)$$

SAR is expressed in units of Watts per Kilogram (W/kg).

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

σ	=	conductivity of the tissue-simulating material (S/m)
ρ	=	mass density of the tissue-simulating material (kg/m^3)
E	=	Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

A1.2 SAR Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 2-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.

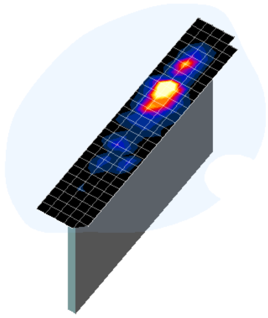

Figure 2-1
Sample SAR Area Scan

3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 2-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
    a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 2-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

    b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

    c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

Table 2-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04*

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid	Graded Grid		
			$\Delta z_{zoom}(n)$	$\Delta z_{zoom}(1)$*	$\Delta z_{zoom}(n>1)$*	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

3 SAR CHARACTERIZATION

A1.1 DSI and SAR Determination

This device uses different Device State Index (DSI) to configure different time averaged power levels based on certain exposure scenarios. Depending on the detection scheme implemented in the smartphone, the worst-case SAR was determined by measurements for the relevant exposure conditions for that DSI. Detailed descriptions of the detection mechanisms are included in the operational description.

When 1g SAR and 10g SAR exposure comparison is needed, the worst-case was determined from SAR normalized to 1g or 10g SAR limit.

The device state index (DSI) conditions used in Table 3-1 represent different exposure scenarios.

Table 3-1
DSI and Corresponding Exposure Scenarios

Scenario	Description	SAR Test Cases
Head (Flip, Flat) (DSI = 2)	▪ Device positioned next to head ▪ Receiver Active	*Head SAR per KDB Publication 648474 D04*
Free Space (DSI = 3)	▪ Motion not detected ▪ Plim > Pmax for all bands/modes	*N/A (Not applicable for portable conditions)*
Hotspot Mode (Flip, Closed) (DSI = 4)	▪ Device transmits in hotspot mode near body in flip or closed mode ▪ Hotspot Mode Active	*Hotspot SAR per KDB Publication 941225 D06*
Body-worn (Flip, Closed) (DSI = 4)	▪ Device being used with a body-worn accessory flip or closed mode	*Body-worn SAR per KDB Publication 648474 D04*
Phablet (Flip) (DSI=4)	▪ Device being used hand in flip mode	*Phablet SAR per KDB Publication 648474 D04*
UMPC Body (Read) (DSI = 5)	▪ Device being used as a UMPC in read mode	*UMPC SAR per KDB Publication 941225 D07*
Body (Flat) (DSI=6)	▪ Device being used as a tablet in flat condition	*Tablet SAR per KDB 616217 D04*

A1.2 SAR Design Target

SAR_design_target is determined by ensuring that it is less than FCC SAR limit after accounting for total device designed related uncertainties specified by the manufacturer (see Table 3-2).

Table 3-2
***SAR_design_target* Calculations for DSI2, DSI4, DSI5, and DSI6 North Antenna**

SAR_design_target			
$SAR\_design\_target < SAR\_regulatory\_limit \times 10^{\frac{-Total\ Uncertainty}{10}}$			
1g SAR (W/kg)		**10g SAR (W/kg)**	
Total Uncertainty	1.0 dB	*Total Uncertainty*	1.0 dB
SAR_regulatory_limit	1.6 W/kg	*SAR_regulatory_limit*	4.0 W/kg
SAR_design_target	1.0 W/kg	*SAR_design_target*	2.5 W/kg

Table 3-3
***SAR_design_target* Calculations for DSI6 South Antenna**

SAR_design_target	
$SAR\_design\_target < SAR\_regulatory\_limit \times 10^{\frac{-Total\ Uncertainty}{10}}$	
1g SAR (W/kg)	
Total Uncertainty	1.0 dB
SAR_regulatory_limit	1.6 W/kg
SAR_design_target	0.8 W/kg

A1.3 SAR Char

SAR test results corresponding to *Pmax* for each antenna/technology/band/DSI can be found in Appendices A1 and A2.

Plimit is calculated by linearly scaling with the measured SAR at the Ppart0 to correspond to the *SAR_design_target*. When *Plimit* < *Pmax*, *Ppart0* was used as Plimit in the Smart Transmit EFS. When *Plimit* > *Pmax* and *Ppart0*=Pmax, calculated *Plimit* was used in the Smart Transmit EFS. All reported SAR obtained from the Ppart0 SAR tests was less than *SAR_Design_target*+ 1 dB Uncertainty. The final *Plimit* determination for each exposure scenario corresponding to *SAR_design_target* are shown in Table 3-3.

Table 3-4
***PLimit* Determination**

Device State Index (DSI)	***PLimit* Determination Scenarios**
2	P_{limit} is calculated based on 1g Head SAR
3	N/A (Not applicable for portable conditions)
4	P_{limit} is calculated based on 1. 1g Flip/Closed Body Worn SAR measured at 10 mm spacing 2. 1g Flip/Closed Hotspot SAR measured at 10 mm spacing 3. 10g Flip Extremity SAR measured at 0 mm spacing
5	P_{limit} is calculated based on 1g UMPC SAR measured at 5 mm spacing
6	P_{limit} is calculated based on 1g Body SAR at 0 mm spacing

Table 3-5
SAR Characterizations

Exposure Senario		Free Space	Head	Flip/Closed Body	Read	Flat	Maximum Tune-Up Output Power*
Averaging Volume		1g, 10g	1g	1g, 10g	1g	1g	
Spacing		-	0 mm	10 mm	5 mm	0 mm	
Configuration		Flip/Closed/ Read/Flat	Flip/Flat	Flip/Closed	Read	Flat	
DSI		3	2	4	5	6	
Technology/Band	Antenna						Pmax
GSM 850	South	30.0	29.6	24.8	21.2	15.7	26.3
GSM 1900	South	30.0	29.8	20.6	15.8	10.9	23.3
UMTS 850	South	30.0	29.9	25.4	21.2	15.7	24.3
UMTS 1900	South	30.0	28.0	20.6	15.0	10.9	24.3
LTE Band 71	South	30.0	31.8	27.0	23.8	17.1	24.3
LTE Band 71	North	30.0	18.7	27.1	23.0	18.1	24.3
LTE Band 12	South	30.0	30.8	26.8	23.5	17.7	24.3
LTE Band 12	North	30.0	18.4	26.1	22.8	17.5	24.3
LTE Band 13	South	30.0	30.2	25.8	21.2	16.4	24.3
LTE Band 13	North	30.0	17.7	26.1	22.0	17.6	24.3
LTE Band 14	South	30.0	30.4	25.9	21.7	16.6	24.3
LTE Band 14	North	30.0	17.5	24.8	22.6	16.7	24.3
LTE Band 26 (Cell)	South	30.0	29.9	23.8	21.2	15.7	24.3
LTE Band 26 (Cell)	North	30.0	17.7	25.9	21.7	16.3	24.3
LTE Band 5 (Cell)	South	30.0	30.5	25.3	21.2	15.7	24.3
LTE Band 5 (Cell)	North	30.0	17.7	25.8	21.7	16.3	24.3
LTE Band 66/4 (AWS)	South	30.0	28.3	17.5	14.5	10.5	24.3
LTE Band 66/4 (AWS)	North	30.0	11.6	17.7	14.2	11.1	24.3
LTE Band 25/2 (PCS)	South	30.0	28.3	20.6	15.8	10.9	24.3
LTE Band 25/2 (PCS)	North	30.0	12.2	18.7	14.9	11.0	24.3
LTE Band 30	South	30.0	28.5	20.9	18.1	9.8	22.4
LTE Band 30	North	30.0	13.8	21.6	17.7	11.8	21.4
LTE Band 7	South	30.0	29.4	18.8	15.2	8.7	24.3
LTE Band 7	North	30.0	12.5	20.0	16.2	9.3	24.3
LTE Band 48	South	30.0	29.7	18.3	13.7	8.8	20.6
LTE Band 41	South	30.0	29.2	18.5	15.7	8.1	22.3
LTE Band 41 (PC2)	South	30.0	29.2	18.5	15.7	8.1	21.7
LTE Band 41	North	30.0	11.9	20.0	15.8	9.3	22.3
LTE Band 41 (PC2)	North	30.0	11.9	20.0	15.8	9.3	20.7
NR Band n71	South	30.0	31.3	27.0	25.6	17.1	22.5
NR Band n71	North	30.0	18.0	26.0	27.1	18.1	22.5
NR Band n5 (Cell)	South	30.0	30.0	24.8	21.2	15.7	22.5
NR Band n5 (Cell)	North	30.0	17.7	25.5	21.7	16.3	22.5
NR Band n66 (AWS)	South	30.0	28.1	17.5	14.5	10.5	22.5
NR Band n66 (AWS)	North	30.0	11.6	17.7	15.1	11.1	22.5
NR Band n25/2 (PCS)	South	30.0	28.8	20.6	15.8	10.9	22.5
NR Band n25/2 (PCS)	North	30.0	12.2	18.7	14.9	11.0	22.5
NR Band n41	South	30.0	27.3	18.5	15.1	8.1	22.5
NR Band n41	North	30.0	11.9	20.0	15.8	9.3	22.5

Notes:

1. When $P_{max} < P_{limit}$, the DUT will operate at a power level up to P_{max}.

4 EQUIPMENT LIST

For SAR measurements

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	CBT	N/A	CBT	3051A00187
Agilent	85033E	3.5mm Standard Calibration Kit	7/7/2021	Annual	7/7/2022	MY53402352
Agilent	E4438C	ESG Vector Signal Generator	12/14/2020	Biennial	12/14/2022	MY42082385
Agilent	E4438C	ESG Vector Signal Generator	9/18/2020	Annual	9/18/2021	MY45091346
Agilent	E4432B	ESG-D Series Signal Generator	2/24/2021	Annual	2/24/2022	US40053896
Agilent	N5182A	MXG Vector Signal Generator	6/21/2021	Annual	6/21/2022	MY47420603
Agilent	N5182A	MXG Vector Signal Generator	6/15/2021	Annual	6/15/2022	MY47420800
Agilent	8753ES	S-Parameter Vector Network Analyzer	9/16/2020	Annual	9/16/2021	MY40000670
Agilent	8753ES	S-Parameter Vector Network Analyzer	2/2/2021	Annual	2/2/2022	US39170122
Agilent	E5515C	Wireless Communications Test Set	2/4/2021	Annual	2/4/2022	GB43193563
Agilent	E5515C	Wireless Communications Test Set	5/6/2021	Annual	5/6/2022	GB44400860
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	353317
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	353468
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433976
Anritsu	MN8110B	I/O Adaptor	CBT	N/A	CBT	6261747881
Anritsu	ML2496A	Power Meter	3/3/2021	Annual	3/3/2022	1306009
Anritsu	ML2496A	Power Meter	4/21/2021	Annual	4/21/2022	1351001
Anritsu	MA2411B	Pulse Power Sensor	12/18/2020	Annual	12/18/2021	1126066
Anritsu	MA2411B	Pulse Power Sensor	9/22/2020	Annual	9/22/2021	1339008
Anritsu	MT8820C	Radio Communication Analyzer	9/17/2020	Annual	9/17/2021	6201300731
Anritsu	MT8821C	Radio Communication Analyzer	9/11/2020	Annual	9/11/2021	6201524637
Anritsu	MT8821C	Radio Communication Analyzer	7/18/2021	Annual	7/18/2022	6262150047
Anritsu	MA24106A	USB Power Sensor	3/2/2021	Annual	3/2/2022	1244524
Anritsu	MA24106A	USB Power Sensor	9/15/2020	Annual	9/15/2021	1520505
Anritsu	MT8862A	Wireless Connectivity Test Set	10/29/2020	Annual	10/29/2021	6261782395
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Control Company	4352	Long Stem Thermometer	1/24/2020	Biennial	1/24/2022	200043588
Control Company	4352	Long Stem Thermometer	1/24/2020	Biennial	1/24/2022	200043655
Control Company	4352	Long Stem Thermometer	5/16/2020	Biennial	5/16/2022	200294604
Control Company	4040	Therm./ Clock/ Humidity Monitor	2/17/2020	Biennial	2/17/2022	200113269
Control Company	4040	Therm./ Clock/ Humidity Monitor	3/6/2020	Biennial	3/6/2022	200170289
Control Company	4040	Therm./ Clock/ Humidity Monitor	3/6/2020	Biennial	3/6/2022	200170313
Insize	1108-150	Digital Caliper	1/17/2020	Biennial	1/17/2022	409193536
Keysight	772D	Dual Directional Coupler	CBT	N/A	CBT	MY52180215
Keysight Technologies	N6705B	DC Power Analyzer	5/5/2021	Triennial	5/5/2024	MY53004059
Keysight Technologies	N9020A	MXA Signal Analyzer	2/24/2021	Annual	2/24/2022	MY48010233
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	NC-100	Torque Wrench	8/4/2020	Biennial	8/4/2022	1445
Pasternack	NC-100	Torque Wrench	8/4/2020	Biennial	8/4/2022	N/A
Rohde & Schwarz	CMW500	Radio Communication Tester	2/18/2021	Annual	2/18/2022	101767
Rohde & Schwarz	CMW500	Radio Communication Tester	3/19/2021	Annual	3/19/2022	128633
Rohde & Schwarz	CMW500	Radio Communication Tester	3/22/2021	Annual	3/22/2022	167283
Rohde & Schwarz	ZNLE6	Vector Network Analyzer	9/29/2020	Annual	9/29/2021	101307
SPEAG	D750V3	750 MHz SAR Dipole	3/16/2020	Biennial	3/16/2022	1003
SPEAG	D750V3	750 MHz SAR Dipole	10/19/2018	Triennial	10/19/2021	1161
SPEAG	D835V2	835 MHz SAR Dipole	1/21/2021	Annual	1/21/2022	4d132
SPEAG	D835V2	835 MHz SAR Dipole	10/19/2018	Triennial	10/19/2021	4d133
SPEAG	D1750V2	1750 MHz SAR Dipole	5/12/2020	Biennial	5/12/2022	1148
SPEAG	D1750V2	1750 MHz SAR Dipole	10/22/2018	Triennial	10/22/2021	1150
SPEAG	D1900V2	1900 MHz SAR Dipole	10/23/2018	Triennial	10/23/2021	5d080
SPEAG	D1900V2	1900 MHz SAR Dipole	2/21/2019	Triennial	2/21/2022	5d148
SPEAG	D1900V2	1900 MHz SAR Dipole	10/23/2018	Triennial	10/23/2021	5d149
SPEAG	D2300V2	2300 MHz SAR Dipole	8/13/2018	Triennial	8/13/2021	1073
SPEAG	D2300V2	2300 MHz SAR Dipole	6/3/2021	Annual	6/3/2022	1116
SPEAG	D2450V2	2450 MHz SAR Dipole	8/14/2020	Annual	8/14/2021	719
SPEAG	D2450V2	2450 MHz SAR Dipole	9/9/2020	Annual	9/9/2021	797
SPEAG	D2450V2	2450 MHz SAR Dipole	1/19/2021	Annual	1/19/2022	981
SPEAG	D2600V2	2600 MHz SAR Dipole	4/14/2021	Annual	4/14/2022	1004
SPEAG	D2600V2	2600 MHz SAR Dipole	6/14/2019	Triennial	6/14/2022	1064
SPEAG	D3500V2	3500 MHz SAR Dipole	1/19/2021	Annual	1/19/2022	1059
SPEAG	D3500V2	3500 MHz SAR Dipole	1/21/2020	Biennial	1/21/2022	1097
SPEAG	D3700V2	3700 MHz SAR Dipole	1/19/2021	Annual	1/19/2022	1018
SPEAG	D3700V2	3700 MHz SAR Dipole	1/21/2020	Biennial	1/21/2022	1067
SPEAG	D5GHzV2	5 GHz SAR Dipole	1/20/2021	Annual	1/20/2022	1057
SPEAG	D5GHzV2	5 GHz SAR Dipole	9/10/2020	Annual	9/10/2021	1191
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/18/2021	Annual	3/18/2022	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/15/2020	Annual	7/15/2021	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/16/2020	Annual	10/16/2021	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/15/2021	Annual	6/15/2022	1334
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/7/2021	Annual	4/7/2022	1407
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/10/2021	Annual	3/10/2022	1415
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/10/2020	Annual	9/10/2021	1449
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/11/2020	Annual	8/11/2021	1450
SPEAG	DAE4	Dasy Data Acquisition Electronics	12/7/2020	Annual	12/7/2021	1533
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/13/2021	Annual	1/13/2022	1558
SPEAG	DAE4	Dasy Data Acquisition Electronics	7/13/2021	Annual	7/13/2022	1583
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/21/2021	Annual	6/21/2022	1676
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/22/2021	Annual	6/22/2022	1677
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/21/2021	Annual	6/21/2022	1678
SPEAG	EX3DV4	SAR Probe	1/20/2021	Annual	1/20/2022	3589
SPEAG	EX3DV4	SAR Probe	7/31/2020	Annual	7/31/2021	7308
SPEAG	EX3DV4	SAR Probe	4/19/2021	Annual	4/19/2022	7357
SPEAG	EX3DV4	SAR Probe	7/20/2021	Annual	7/20/2022	7406
SPEAG	EX3DV4	SAR Probe	6/21/2021	Annual	6/21/2022	7409
SPEAG	EX3DV4	SAR Probe	7/20/2020	Annual	7/20/2021	7410
SPEAG	EX3DV4	SAR Probe	7/20/2021	Annual	7/20/2022	7410
SPEAG	EX3DV4	SAR Probe	3/16/2021	Annual	3/16/2022	7526
SPEAG	EX3DV4	SAR Probe	11/23/2020	Annual	11/23/2021	7538
SPEAG	EX3DV4	SAR Probe	10/20/2020	Annual	10/20/2021	7539
SPEAG	EX3DV4	SAR Probe	10/20/2020	Annual	10/20/2021	7551
SPEAG	EX3DV4	SAR Probe	12/11/2020	Annual	12/11/2021	7571
SPEAG	EX3DV4	SAR Probe	6/29/2021	Annual	6/29/2022	7659
SPEAG	EX3DV4	SAR Probe	6/28/2021	Annual	6/28/2022	7660
SPEAG	DAK-3.5	Dielectric Assessment Kit	10/14/2020	Annual	10/14/2021	1091
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	N/A

Note:

1. CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.
2. Each equipment item was used solely within its respective calibration period.

5 MEASUREMENT UNCERTAINTIES

For SAR Measurements

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	IEEE 1528 Sec.	Tol. (± %)	Prob. Dist.	Div.	c_i 1gm	c_i 10 gms	1gm u_i (± %)	10gms u_i (± %)	v_i
Measurement System									
Probe Calibration	E.2.1	7	N	1	1	1	7.0	7.0	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	E.2.3	2	R	1.73	1	1	1.2	1.2	∞
Linearity	E.2.4	0.3	N	1	1	1	0.3	0.3	∞
System Detection Limits	E.2.4	0.25	R	1.73	1	1	0.1	0.1	∞
Modulation Response	E.2.5	4.8	R	1.73	1	1	2.8	2.8	∞
Readout Electronics	E.2.6	0.3	N	1	1	1	0.3	0.3	∞
Response Time	E.2.7	0.8	R	1.73	1	1	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1	1	1.5	1.5	∞
RF Ambient Conditions - Noise	E.6.1	3	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	3	R	1.73	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.73	1	1	0.5	0.5	∞
Probe Positioning w/ respect to Phantom	E.6.3	6.7	R	1.73	1	1	3.9	3.9	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	4	R	1.73	1	1	2.3	2.3	∞
Test Sample Related									
Test Sample Positioning	E.4.2	3.12	N	1	1	1	3.1	3.1	35
Device Holder Uncertainty	E.4.1	1.67	N	1	1	1	1.7	1.7	5
Output Power Variation - SAR drift measurement	E.2.9	5	R	1.73	1	1	2.9	2.9	∞
SAR Scaling	E.6.5	0	R	1.73	1	1	0.0	0.0	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	E.3.3	4.3	N	1	0.78	0.71	3.3	3.0	76
Liquid Permittivity - measurement uncertainty	E.3.3	4.2	N	1	0.23	0.26	1.0	1.1	75
Liquid Conductivity - Temperature Uncertainty	E.3.4	3.4	R	1.73	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	E.3.4	0.6	R	1.73	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Combined Standard Uncertainty (k=1)			RSS				12.2	12.0	191
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.4	24.0	